

## REMARKS

### STATUS OF THE APPLICATION

The Applicants wish to thank the Examiner for her clear explanation of the rejections in the Final Office Action dated April 08, 2005.

Claims 11-12 and 16-21 are pending in this application. Claims 11-12 and 16-21 have been rejected. Specifically, Claims 11-12, 16, and 18-21 are rejected under 35 U.S.C. § 102(b) and 35 U.S.C. § 103(a). Claim 17 has been rejected under 35 U.S.C. § 103(a).

Applicants have canceled Claim 17.

### RESPONSE TO REJECTION UNDER 35 U.S.C. § 102(B)

#### (I) U. S. PATENT 6,063,448 TO DUECOFFRE, ET AL.

Claims 11, 12, 16 and 18-21 have been rejected under 35 U.S.C. 102(b) as anticipated by U.S. Patent 6,063,448 to Duecoffre, *et al.* (hereinafter "Duecoffre").

Applicants believe that Duecoffre teaches away from the present invention. Duecoffre teaches a process for coating using a two-layer system of a base coat and a clear coat. The clear coat is applied from a non-aqueous coating medium containing a hydroxyl-functional binder. Said hydroxyl-functional binder is based on a hybrid polymer system of (meth)acrylic copolymer and a hydroxy-functional polyester. Further, the (meth)acrylic copolymer is prepared in the presence of the polyester polyol.

The hybrid polymers used in Duecoffre are different from a simple physical mixture of a (meth)acrylic copolymer and polyester polyol as seen in the present invention. The Examiner suggests that the polyester described in Duecoffre is similar to the polyester polyol (a) of the present invention. However, Duecoffre's clear coat does not contain a polyester polyol, but instead contains a hybrid binder comprising polyester polyol as one part and the (meth)acrylic acid as the second part.

Further, the (meth)acrylic copolymer portion has been prepared by free-radical polymerization in presence of hydroxy-functional polyesters.. The degree of

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entanglement of the two different polymer chains is greater in the hybrid polymer system (Duecoffre) than in a simple physical mixture (of the present invention).

Additionally, both of the polymer portions of the hybrid polymer system or the binder may be covalently bonded. The free-radical polymerization of the monomeric mixture builds up the vinyl polymer portion of the hybrid binder. This may be through copolymerization or graft polymerization of the olefinically unsaturated monomers with or onto olefinic double bonds of the polyester resin. The polymerization may also occur in the presence of a polyester resin, free of olefinic double bonds. Alternatively, there may be a graft polymerization of the olefinically unsaturated monomers onto the polyester portion of the polyester/vinyl polymer hybrid binder initiated by proton loss from the polyester resin. Therefore, Duecoffre does not teach polyester polyol (a) of the present invention, but instead teaches hybrid polymers.

Moreover, in Claim 11 part (c) and Claim 12 part (c) of the present invention, the calculated hydroxyl functionality for the polyester polyol is from 4.5 to 10. Duecoffre, however, is silent with regard to the hydroxyl functionality of the present invention, and therefore, Duecoffre does not teach or suggest the present invention.

Also, Duecoffre teaches away from the claimed quantitative composition of components (a1) and (a2) of the present invention, which require that the hydroxyl components and carboxyl components comprise no more than 20 wt-% of at least one diol and at least one monocarboxylic acid, respectively. To the contrary, Example 1 of Duecoffre comprises 57.8 wt-% of monocarboxylic acid (isononanoic acid) among the carboxyl components and Example 2 of Duecoffre comprises 57 wt-% diol (hexane diol) among the hydroxyl components. In these Examples, both values (the 57.8 wt-% and 57 wt-%) are far above the upper limit disclosed in the present invention, which is 20 wt-% in either case. This upper limit is set at 20 wt-% to ensure the high level of hydroxyl-functionality of the final polyester of the present invention.

Further, it appears that the Examiner has misconstrued the Duecoffre's teachings by erroneously linking one portion of the reference to another portion of the reference, which is not permitted under a judicial interpretation by the Court of Appeals for the Federal Circuit (*See Echolochem, Inc. v. Southern California Edison Co.*, 227 F.3d 1361, Fed. Cir. 2000). Specifically, Duecoffre's polyesters are ordinarily known polyesters. On the other hand, the polyesters claimed in the present invention with the specific combination of limitations cannot be found in

Duecoffre. A hypothetical person skilled in pertinent art desirous of developing polyester based clear coat with the advantageous properties described in the present application would not look into Duecoffre as closest prior art. Nevertheless, if the skilled person were to do so he/she would not find any suggestion or combination in Duecoffre's disclosure describing the limitations claimed in the present invention. If such person were to look at polyesters described in Duecoffre's Example in order to find the best mode polyesters, such polyesters, however, would teach away from our specifically limited polyesters.

**(II) U. S. PATENT 6,063,448 TO DUECOFFRE, ET AL. AND**  
**U. S. PATENT 4,880,490 TO MIYABAYASHI, ET AL.**

Claims 11 has been rejected under 35 U.S.C. 102(b) as anticipated by, or in the alternative, obvious under 35 U.S.C. §103(a) over U.S. Patent 6,063,448 to Duecoffre, *et al.* (hereinafter "Duecoffre").

Initially, Applicants wish to indicate that the Examiner has included U. S. Patent 4,880,890 to Miyabayashi, *et al.* (hereinafter "Miyabayashi") in the discussion of this rejection, although Claim 11 has not been rejected over the specific combination of Duecoffre and Miyabayashi. However, even if the Examiner proffered this combination of references, such a combination would not render the present invention obvious.

In the interests of expediting prosecution, Applicants offer the following remarks. As noted above, Duecoffre teaches away from the present invention because Duecoffre describes hybrid polymers rather than the mixtures of the present invention. Thus, the use of polyesters described in Miyabayashi in the teachings of Duecoffre would again result in hybrid polymers rather than a simple mixture of a (meth)acrylic copolymer and polyester polyol. Additionally, Miyabayashi neither teaches nor suggests that the polyesters described therein are suitable for use as a binder in clear coats for base coat/clear coat two-layer coating having the properties of the present invention. Therefore, Applicants respectfully request that the rejection be withdrawn.

**RESPONSE TO REJECTION UNDER 35 U.S.C. § 103(A)**

**(I) U. S. PATENT 4,880,490 TO MIYABAYASHI, ET AL. AND**

**U. S. PATENT 5,023,141 TO WILLEY**

Claims 11, 12, 16, 18-21 have been rejected under 35 U.S.C. 103(a) as being unpatentable over U. S. Patent 4,880,890 to Miyabayashi, *et al.* (hereinafter "Miyabayashi") in view of U. S. Patent 5,023,141 to Willey (hereinafter, "Willey").

**Examiner's Hypothesis**

Miyabayashi fails to teach that the polyester primer is colored base coat and the substrate is automotive body and body parts. Willey teaches that high solids colored polyester primer (base coat) can be primarily used in the manufacture of automobiles for coating steel, aluminum or plastic substrates to cover imperfections in surfaces and provides the surface to which conventional topcoats will adhere.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used high solids colored polyester primer of Willey as a primer (base coat) in Miyabayashi for covering automobile bodies or body parts with the expectation of providing the desired coverage of imperfections in surfaces, since Willey teaches that high solids colored polyester primer(base coat) can be primarily used in the manufacture of automobiles for coating steel, aluminum or plastic substrates to cover imperfections in surfaces and provides the surface to which conventional topcoats will adhere.

**Applicants' Remarks**

The Applicants respectfully disagree with the Examiner's reasoning of obviousness under 35 U.S.C. § 103(a) with reference to Miyabayashi in view of Willey.

Section 2142 of the MPEP indicates that a *prima facie* case of obviousness is established only when:

- (1) all of the claim limitations are either taught, or suggested by the cited prior art;
- (2) there is some suggestion or motivation to modify or combine the cited prior art references; AND

- (3) there is a reasonable expectation of successfully producing the claimed invention via such a combination.

Applicants respectfully submit that because the first prong of the obviousness inquiry is not satisfied, a *prima facie* case of obviousness is not established. All claim limitations of the present invention with respect to the cited claims are not taught or suggested by Miyabayashi in view of Willey. Specifically, the Examiner has equated a primer (from Willey) with base-coat (from Miyabayashi). To one ordinarily skilled in the pertinent art, the term "primer" and the term "base-coat" refer to two different entities. Applicants respectfully suggest review of two documents attached with the present petition, viz. (1) Ullmann's Encyclopedia of Industrial Chemistry (5<sup>th</sup> Edition, Vol A 18, pp 517-519) and (2) Automotive Paints and Coatings, Edited by G. Fettis, VCH publication. Relevant sections are highlighted to show the difference between a primer and a base-coat as used automotive industrial practice.

Applicants respectfully submit a *prima facie* case of obviousness is also not established because the second prong of the obviousness inquiry is not satisfied. The second prong of the obviousness inquiry states that there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings is not satisfied (See *In re Lee*, 277 F.3d 1338 (Fed. Cir. 2002)). Specifically, neither Miyabayashi, nor Willey, express any suggestion or motivation to combine the two references to arrive at the claims of the present invention that are in question.

Applicants further respectfully submit a *prima facie* case of obviousness is also not established because even the third prong of the obviousness inquiry is not satisfied. Applicants do not believe that the combination of Miyabayashi with Willey teaches or suggests the present invention. There is no likelihood or an expectation of success from such a combination. The present invention utilizes a color-imparting and/or special effect-imparting base coat while Willey is directed to a primer composition and such compositions are not generally interchangeable. Therefore the combination does not teach or suggest the preparation of automotive coatings having a color and/or special effect imparting base coat as a first layer and clear coat as an external layer.

Therefore, Applicants respectfully submit that the Examiner has not met her burden of proof in establishing a *prima facie* case of obviousness, and therefore, Miyabayashi in view of Willey do not render the claims of the present invention in question, obvious.

### **CONCLUSION**


In view of the above remarks, Applicants respectfully submit that stated grounds of rejection have been properly traversed, accommodated, or rendered moot and that a complete response has been made to the Office Action mailed April 08, 2005.

Therefore, Applicants believe that the application stands in condition for allowance with withdrawal of all grounds of rejection. A Notice of Allowance is respectfully solicited. If the Examiner has questions regarding the application or the contents of this response, the Examiner is invited to contact the undersigned at the number provided.

There are no fees due in accordance with this response. However, should a fee be due that is unaccounted for, please charge such fee to Deposit Account No. 04-1928 (E. I. du Pont de Nemours and Co.). Furthermore, if any extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. §1.136(a), and any fees required therefore are hereby authorized to be charged to our Deposit Account No. 04-1928.

Respectfully submitted,

Date: July 8, 2005

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# Automotive Paints and Coatings

Edited by Gordon Fettis



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## 5 Topcoats for the Automotive Industry

U. Poth

### 5.1 Definitions

Topcoats have as their main target to provide stability of the coating system against mechanical and chemical attack and to build an appealing effect. To fulfill all these aims, topcoats can consist of different layers. Whereas the traditional, so called solid colour topcoats consists of only one layer, today most of the metallic topcoats consist of two layers, the metallic basecoat and a clearcoat. Based on the experience with this two-layer system, there is a trend to apply solid colour topcoat systems in two layers as well. For special high quality topcoat systems there is the use of a solid colour precoat, which is applied before the topcoat to provide optimum smoothness and colour appearance. Usually, for the application of automotive coating systems there are three stoving processes: for the primer, the primer surfacer and the topcoat system. In the case of using a solid colour precoat four stoving times are required.

While the layer of primers for automotive coatings have a thickness of 18–23  $\mu\text{m}$  (0.71–0.91 mils), the layer of primer surfacers have approx. 35  $\mu\text{m}$  (1.38 mils), the solid colour topcoats have ca. 40  $\mu\text{m}$  (1.57 mils), the metallic basecoats have 12–15  $\mu\text{m}$  (0.47–0.59 mils) and the clearcoats have approx. 40  $\mu\text{m}$  (1.57 mils), see Figure 5.1 [5.1].

Repair coats [5.2] are used for cars after any damage to the car body or in the case when an old coating system is no longer good in appearance or resistance. Repair coating systems consist of primers, primer surfacers, topcoats (in the special meaning of solid colour topcoats), basecoats and clearcoats ('after market repair'). The main difference between the OEM systems and the repair coats is the application method and more specifically the film building conditions. While the OEM topcoats will be stoved after spray application in tunnel ovens at temperatures of 120–150 °C (248–302 F) to build films with optimum properties, repair topcoats have to build resistant coat films at ambient temperatures or possibly at temperatures up to 60 °C (140 F). Therefore, the contents of repair coats are different to those of OEM coat systems.

If this damaging occurs during the coating process in the application line, the quality controller in the car plant can decide to run a repair coat application for a small part of the car or for the total car body. In the latter case the repair coat application will run under the same conditions as in the first coating process ('high-bake-repair' on line).

If any damage to the coated car body is observed in a later state of the car construction and it is necessary to repair the coating system, the application of a repair coat runs always at temperatures about 80–90 °C (176–194 F). For this so called 'low-bake-repair' a special coating system has to be used.

Solid colour	Metalllic
Solid colour topcoat approx. 40 $\mu\text{m}$ (1.57 mils)	Clearcoat approx. 40 $\mu\text{m}$ (1.57 mils)
	Basecoat 12 - 15 $\mu\text{m}$
Primer/surfacer approx. 35 $\mu\text{m}$ (1.38 mils)	
Electrocoat primer 18 - 23 $\mu\text{m}$ (0.71 - 0.91 mils)	
Substrate: steel and inhibition layer	

Figure 5-1. Layers of automotive coating systems.

Additionally there is an increase of the use of plastic parts in the construction of car bodies.

Coatings for plastic parts are quite different from those for the steel parts of a car body (see Chapter 6). Plastic parts can not be heated to higher temperature without loss of properties. Therefore topcoats for these parts are applied separately from the car body and the conditions of film building are at lower temperatures, normally 60–80 °C (140–176 F) in some special cases higher (max. 120 °C, 250 F) [5.3]. Therefore topcoats for plastic parts are related to repair topcoats, but one has to achieve a much higher flexibility for this type of topcoat.

## 5.2 The Development of the Different Automotive Topcoat Systems [5.4] (see Chapter 1)

The coating materials of the first cars consisted of air drying binder systems based on vegetable oils and resins: rosin and copals. Copals are semifossil resins of trees which grew in the tropics [5.5]. In England, this coating technology, based on the combination of vegetable oils and copals in a hot blend process, was developed to a high quality. For the coating process 20 separately painted coat layers are required and up to 3 weeks work time. In the twenties the demand for automotive cars increased rapidly and production assembly lines were invented and developed. Topcoats based on cellulose nitrate as a film building vehicle were used. Cellulose nitrate was combined with plasticisers, and the coating systems which consisted of this combination performed fast drying at ambient conditions and had good appearance [5.6].

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and second primers prevent corrosion of the metal surface. The pigments and extenders allow the primers to react with ions ( $\text{Cl}^-$  and  $\text{SO}_4^{2-}$ ) that diffuse into the film from the atmosphere. The pigmented organic film also forms a barrier against humidity that may otherwise initiate a corrosive process.

Heavy-metal pigments (mainly lead pigments) and zinc chromates were used successfully in earlier decades. These pigments are now being replaced by nontoxic pigments (see Section 11.3.1, and  $\rightarrow$  Pigments Inorganic).

The first and second topcoats build up the necessary dry film thickness and protect the entire coated construction against the adverse influence of the atmosphere.

Binders based on linseed oil and other oils have been used for many years in anticorrosive primers. Alkyd binders, especially those with high fatty acid contents, perform similarly. The main disadvantages of these binders is their limited chemical resistance and their slow drying.

Chlorinated rubber and poly(vinyl chloride) (PVC) resins allow the formulation of coatings with good chemical resistance. They are therefore used for steel constructions in chemical plants. Since they are not resistant to many organic solvents, they should not be used in oil refineries or plants handling solvents. The undesirable fact that these binders contain halogens in high amounts is responsible for their decreasing use. Overspray of chlorinated rubber and PVC paints and contaminated blasting materials produced after removing old paint cause severe problems in waste incineration plants (generation of hydrochloric acid), as well as in waste disposal areas (pollution of soil and water).

Epoxy resins cured with aminoamide resins or amine adducts are often used for large metal constructions. Paints based on these resins are normally applied in four layers. Epoxy coatings form films that are resistant to organic solvents and a wide range of chemicals. Epoxy coatings are currently used for the majority of steel and aluminum constructions, but are also suitable for use on other construction materials (e.g., concrete). They can protect buildings in chemical plants and nuclear power plants. Epoxy coatings are less susceptible to deterioration by radiation than other organic films, and are also resistant to decontaminating chemicals (usually aqueous detergent solutions) used to remove radioactive dust from walls and other surfaces in nuclear power plants.

Heat-resistant coatings have silicone-resin binders. Pigments for such paints are zinc dust, flakes of aluminum or stainless steel, titanium dioxide, or silicon carbide. Such paints can withstand temperatures up to  $600^\circ\text{C}$ .

Paints with inorganic binders are also used for corrosion protection of steel constructions. These paints are based on organic silicates which are soluble in mixtures of alcohols or other water-miscible solvents (see Section 2.15.2). Ethyl silicate is often used and mostly pigmented with zinc dust. Zinc-rich primers and single coats are available as one- or two-pack products. Zinc-rich ethyl silicate paints dry to form inorganic films that are very durable even under adverse atmospheric conditions, (e.g., onshore and at sea). These coatings have excellent resistance to oil, solvents, and mechanical impact, and are therefore used on drilling stations, oil rigs, and ships. Since zinc-rich silicate coatings are heat resistant, they are also used in hot areas of iron works, coal mines, and coking plants.

Heavy-duty coatings are often still applied manually with brushes or rollers that completely wet the metal surface; holes and pores are filled with paint. This is especially important when old, partially rusted constructions are repainted after sanding. Brushing and rolling, however, only allow a slow working speed. Larger surface areas must be painted with airless spraying equipment.

## 11.2. Automotive Paints

### 11.2.1. Car Body Paints

Cars are coated to achieve maximum, long-lasting corrosion resistance. Cars must also be given an optimum appearance that lasts for many years. Long-lasting color and gloss retention as well as resistance against cracking (especially in clearcoats of two-coat metallics) are therefore necessary. Topcoats of automobiles must withstand solar radiation and atmospheric pollution (e.g., acid rain and soot from oil combustion). Aggressive chemicals (e.g., road salts and cleaning agents containing detergents) can damage the coating if they come into contact with the car surface. Furthermore, small stones cause heavy impact on automobile surfaces and corrosion via chipping.

Large numbers of cars are manufactured on fast-running assembly lines. The paints must

therefore be applied with highly efficient equipment, and must dry very quickly. The paint products are classified as primers, intermediate coats (also called fillers or surfacers), and topcoats (or finish). The primers and fillers are designated as the undercoating system.

Car paints are cured with heat in special oven lines. Electrodeposition coatings (used as anticorrosive primers) contain only small amounts of volatile organic compounds (VOC), whereas intermediate and topcoats release considerable amounts of VOCs. Intermediate coats based on waterborne resins have been developed to decrease VOC emission and are already being used in some automotive plants. Basecoats, as part of base-clear topcoat systems, contain very high amounts of volatile organic solvents. Waterborne basecoats were developed more recently to lower this source of solvent emission. Some car manufacturers are operating pilot lines with the aim of introducing waterborne basecoats into their production processes. Many car producers in the United States and Europe have already switched their topcoat lines over to waterborne basecoats [11.3].

**Pretreatment.** Various metals are used for manufacturing car body shells: steel, galvanized steel, aluminum alloys, and zinc-rich precoated steel. The surfaces of these metals are routinely contaminated with oils, drawing lubricants, dirt, and assembly residues (e.g., welding fumes). The body shells are pretreated to remove these contaminants and to obtain a well-defined, homogeneous surface that has the necessary properties for adhesion of primers. Pretreatment includes surface cleaning and formation of a phosphate conversion coat on the shell surface (see Section 8.2.1); six to nine discrete steps are involved using either spraying devices or baths. Continuous control of phosphating solutions ensures good results [11.1], [11.4].

**Anticorrosive Primers.** Anticorrosive primers are applied in dip tanks so that they reach all parts of the car body; dipping is a fast method of application. The standard method for application of primers is electrodeposition. Anodic electrodeposition paints were used when the electrocoating technique was first applied, but cathodic electrodeposition is now predominant because it provides better corrosion protection.

The binders for cathodic electrodeposition are epoxy resin combinations dispersed in water (see Section 3.8). Advantages of anticorrosive electrocoatings include excellent corrosion resistance at a dry film thickness of ca. 20–30  $\mu\text{m}$ . Electrocoats are stored at 165–185°C to obtain films with the desired properties. The paint industry is now developing electrocoats that can be cured at lower temperatures (140–150°C). Electrocoating produces a homogeneous film that covers the entire car body surface, including recesses and cavities.

Although the dry film thickness on the metal edges is somewhat lower, these areas are still efficiently protected against corrosion. The ultrafiltration technique results in a very high transfer effect and a uniform coating: paint solids from the bath are deposited on the metal surface without loss. Since electrodeposition paints have a low organic solvent content, air pollution is low. The dip tank contents are not flammable, which reduces insurance costs [11.5].

**Intermediate Coats.** Intermediate coats (fillers) are applied between the anticorrosive primers and the topcoat systems. They provide good filling and flowing layers which are normally smoothed by sanding. Oil-free polyesters are used as binders for fillers. They react with blocked isocyanates in 20 min at 165°C. Their high flexibility gives the whole coating system a highly effective mechanical (stone chip) resistance.

Fillers are applied with electrostatic spraying devices (fast-rotating bells) to give dry film thicknesses of about 40  $\mu\text{m}$ . Waterborne fillers with polyester-melamine binders (primer surfacers) have been developed to reduce the volatile organic content. They yield a film thickness of 30  $\mu\text{m}$  after a prereaction time of 10 min at 100°C and a reaction time of 20 min at 165°C. The properties of the films are similar to those formed by solventborne paints. More recently, waterborne fillers based on blocked isocyanates have been developed. Field trials have shown that their mechanical resistance is very good.

**Topcoat Systems.** Topcoats form an important part of the protection system of the car body surface, but are much more important for decoration. The basic requirements for a car topcoat are:

- 1) Full, deep gloss (wet-look)
- 2) Highly brilliant metallic effects
- 3) Long-lasting resistance against weather and chemical influences
- 4) Easy to polish and repair

Topcoats based on nitrocellulose combinations with plasticizers and alkyd resins were used in the first decades of industrial car manufacturing. These were followed by thermosetting alkyd-melamine combinations, and later by thermosetting acrylics. The use of stoving enamels as thermosetting paints also accelerated production significantly. Although the properties of these coatings during application and in use were very good, their high content of volatile organic solvents had to be lowered to comply with legal restrictions.

The basecoat-clearcoat system is presently the most commonly used type of topcoat for cars because it is the standard application system for metallic colors. Today, about 70% of all cars have metallic topcoats. The basecoat-clearcoat system consists of a colored layer (basecoat) which is overcoated after a short flash-off time with a protective layer of clearcoat. Both coats are cured together at 120–140°C. The basecoat contains pigments which provide two types of finish: solid (straight) colors or metallic.

Solventborne metallic basecoats contain ca. 15% solids and ca. 85% volatile organic solvents. These solvents are not released into the atmosphere, but are converted to combustion gases in afterburners. To reduce emission of organic solvents from this source, waterborne basecoats have been developed.

Waterborne basecoats with higher solids contents are now available: metallic basecoats contain about 18 wt% solids and solid (straight) color basecoats 25–40 wt%. The solvent in waterborne paints is not pure water; about 15% of organic solvents is still needed as a cosolvent for proper film formation. Metallic basecoats are applied at a DFT of 15 µm, solid color basecoats at a DFT of 20–25 µm.

Basecoats are sprayed in two layers. The first layer is sprayed electrostatically with high-speed rotation bells, the second layer is sprayed with compressed air to achieve proper orientation of the aluminum particles in metallic paints. The basecoat is then dried for 3–5 min in a warm air zone at 40–60°C.

A final layer of clearcoat is applied with electrostatic high-speed rotation bells [11.3], [11.7]

to protect the system against atmospheric influences, including wear and tear during use.

Alkyd-melamine clearcoats with an approximate solids content of 50% contain UV-absorbing agents to prevent deterioration in extreme climates.

Some car manufacturers use clearcoats with acrylic binders that are cured with aliphatic isocyanates. Their chemical and mechanical properties are better than those of alkyd-melamine clearcoats. Solid contents are as high as 58%.

**Car Repair Paints [11.1].** Repair paints are used in considerable amounts for refinishing cars. Since repair shops cannot provide the same facilities as those of car manufacturers, repair paints are dried at ambient temperature or elevated temperature up to 80°C (metal temperature). Alkyd repair paints and nitrocellulose paints were standard materials, but two-pack acrylate-isocyanate refinish paints are now more common. Their properties are similar to those of the original car coatings (long-lasting gloss and color, mechanical and fuel resistance). Car refinish paints are available in a wide range of colors, solids as well as metallics. They are often supplied to shops and retailers as mixing schemes.

Paint systems for car repair comprise anticorrosive primers, putties, intermediate coats, and topcoats; repair coatings applied to refinished cars have similar durabilities to those of the originally manufactured coating systems.

#### 11.2.2. Other Automotive Coatings

The properties of coating systems used for car components differ considerably from those of systems used for exterior car surfaces. Color is not important (and is mainly black or gray), but anticorrosive properties similar to those of car body coatings are required. Since car components are produced in large numbers, coatings are commonly baked at high temperature to ensure a high reaction rate and rapid film formation.

Wheels are electrocoated; engine blocks are coated with heat-resistant, usually waterborne materials. Other parts (e.g., steering equipment and shock absorbers) are painted with two-pack, one-coat epoxy systems that are usually solventborne; use of waterborne systems is, however, increasing.

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